DOCUMENT RESUME

ED 451 063 SE 064 623

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TITLE Teaching Math and Science in the Real World.
INSTITUTION North Central Regional Educational Lab., Oak Brook, IL.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE 2000-00-00
NOTE 25p.; Many color photos will not reproduce adequately.
CONTRACT RJ96006301
AVAILABLE FROM North Central Regional Laboratory, 1900 Spring Road, Suite 300, Oak Brook, IL 60523-1480. Tel: 800-356-2735 (Toll Free); Fax: 630-571-4716; e-mail: info@ncrel.org; Web site: http://www.ncrel.org.
PUB TYPE Collected Works - Serials (022)
JOURNAL CIT NCREL's Learning Point; v2 n3 Fall 2000
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Standards; *Educational Change; Elementary Secondary Education; Environmental Education; *Mathematics Education; Relevance (Education); *Science Education

ABSTRACT

This issue offers a collection of timely topics focused on mathematics and science education. It uncovers the past, present, and future of the national standards movement in mathematics and science education with two articles entitled "Setting Standards for Excellence" and "On the Road to REAL Progress." A close-up look at students doing real-life water ecology research is provided. This issue also features articles on "Math Wars," teacher shortages, and curriculum research centers. (ASK)

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NCREL's LEARNING POINT

North Central Regional Educational Laboratory

Fall 2000

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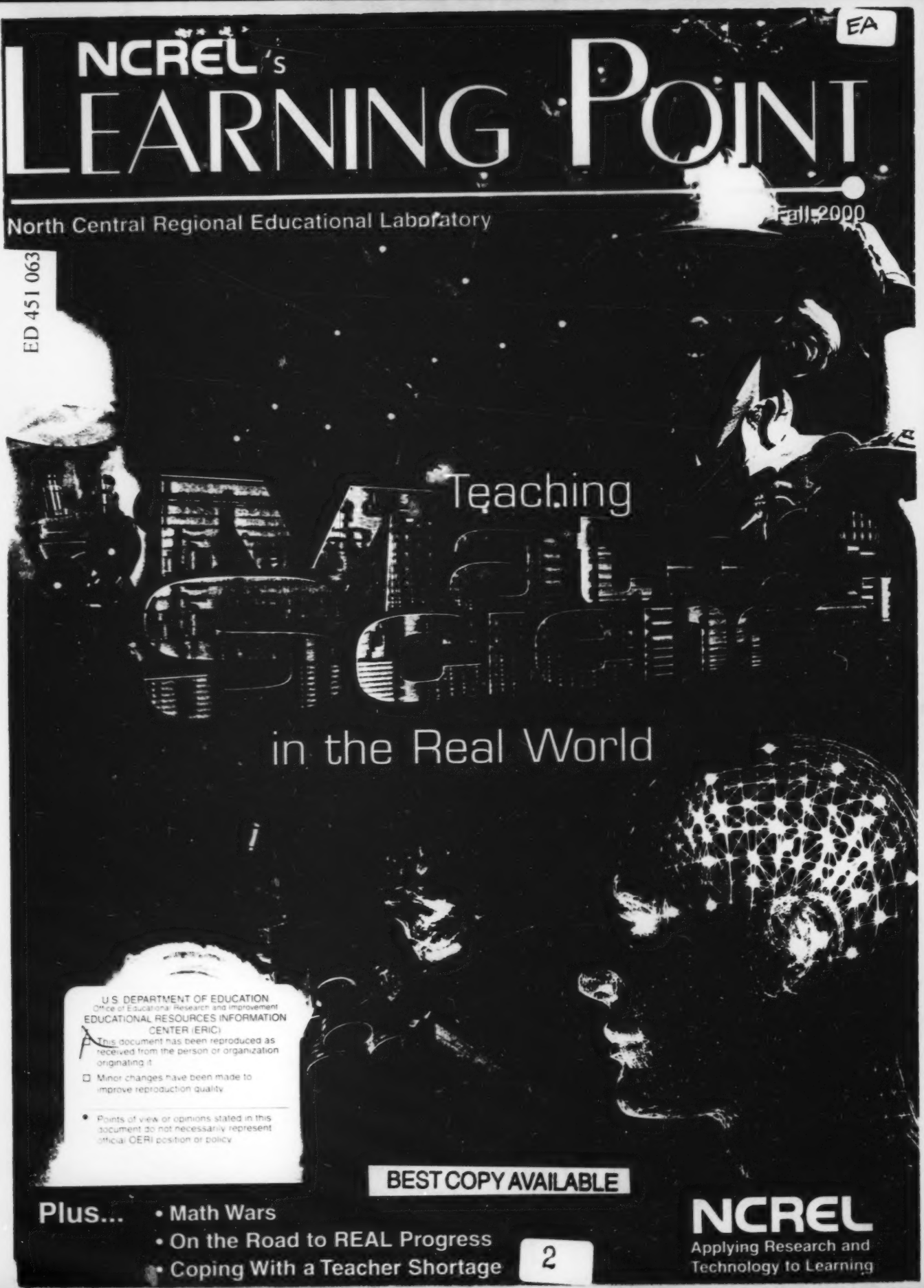

Teaching Science in the Real World

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- On the Road to REAL Progress
- Coping With a Teacher Shortage

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NCREL's
LEARNING POINT

Fall 2000 Volume 2, No. 3

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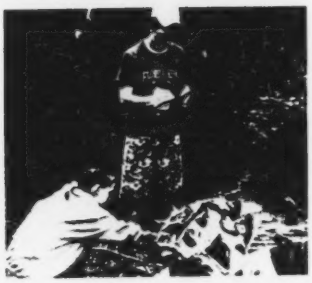

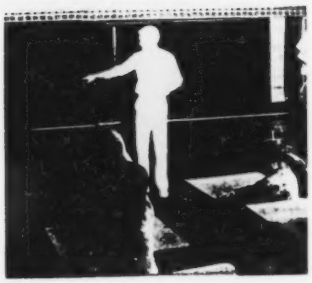

Cover: Enrique Cruz Jr.

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This work was produced in whole or in part with funds from the Office of Educational Research and Improvement (OERI), U.S. Department of Education, under contract number RJ96006301 and grant numbers R168R50003 and R302A50007. The content does not necessarily reflect the position or policy of OERI or the Department of Education, nor does mention of trade names, commercial products, or organizations imply endorsement by the federal government.

A Special Message from Gina Burkhardt, Executive Director

Nearly 20 years ago I walked into a school in rural, upstate New York to teach mathematics and science to two classrooms of seventh and eighth graders. It was only November and I was already the second teacher attempting to make it through the year with this particularly rambunctious group of students. And, if that weren't enough, I was informed that in addition to teaching math and science, "other duties as assigned" meant teaching social studies and gym. I entered that classroom straight from the university without any support: no mentor, no resources, and certainly no Internet.

The teaching profession has come a long way since then, but not far enough. NCREL strives to provide meaningful, relevant resources for schools and classroom teachers—from rookies to veterans. This issue of *NCREL's Learning Point* offers a collection of timely topics focused on my former areas of practice—math and science. But, even if you're not a math or science teacher, this issue provides a variety of articles that are worth taking the time to read.

Learn what's happening on the frontline of school reform as *NCREL's Learning Point* writers tackle tough issues such as standards, math wars, and teacher shortages. Also, discover regional resources that assist educators in the pursuit of achieving improved performance by all students.

All of today's students deserve qualified and prepared teachers. NCREL takes seriously its charge to support learning by supporting teachers to do their best work. These resources are a small part of the contribution that NCREL makes to this field.

And, to all my former students—what percentage of 256 is 32?

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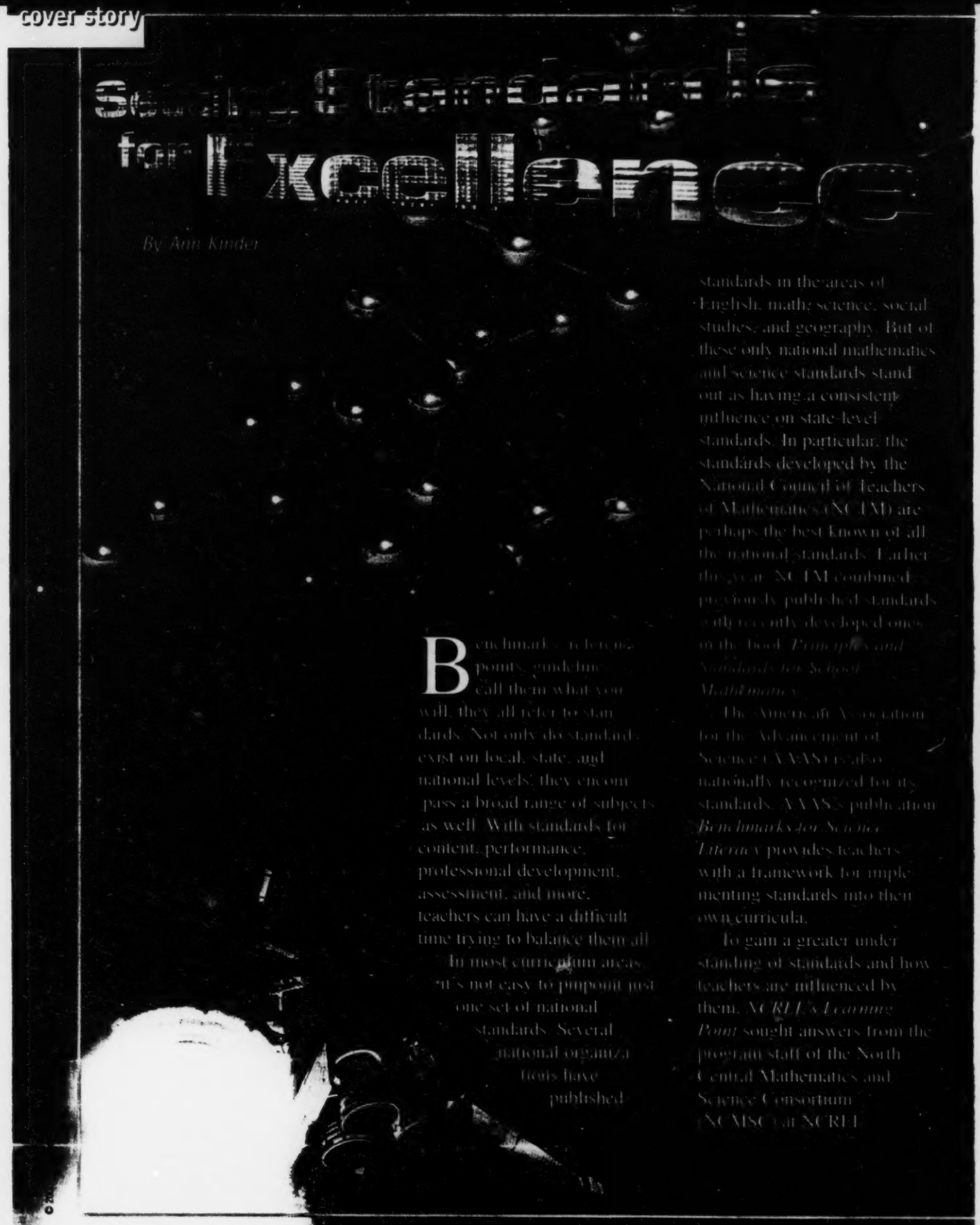
Standards for Excellence

By Ann Kinder



Benchmarks, reference points, guideline—call them what you will, they all refer to standards. Not only do standards exist on local, state, and national levels; they encompass a broad range of subjects as well. With standards for content, performance, professional development, assessment, and more, teachers can have a difficult time trying to balance them all.

In most curriculum areas, it's not easy to pinpoint just one set of national standards. Several national organizations have published standards in the areas of English, math, science, social studies, and geography. But of these only national mathematics and science standards stand out as having a consistent influence on state-level standards. In particular, the standards developed by the National Council of Teachers of Mathematics (NCTM) are perhaps the best known of all the national standards. Earlier this year, NCTM combined previously published standards with recently developed ones in the book *Principles and Standards for School Mathematics*.

The American Association for the Advancement of Science (AAAS) is also nationally recognized for its standards. AAAS's publication *Benchmarks for Science Literacy* provides teachers with a framework for implementing standards into their own curricula.

To gain a greater understanding of standards and how teachers are influenced by them, *NCREL's Learning Point* sought answers from the program staff of the North Central Mathematics and Science Consortium (NCMSC) at NCREL.

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NCREL's Learning Point: What is the standards movement?

NCMSC: The standards movement is not about imposing another content area, it's about establishing criteria for excellence. You don't want to teach standards, you want to have standards to teach toward. Students should be accountable for their learning and teachers accountable for their teaching.

In education, we've never had a set of reference points on how to judge students' knowledge. In the summer Olympics, how do the gymnastics judges know who should win the competition? How do they know what elements need to be included in a floor routine? How do they judge the difficulty of a vault? The answer is, they have standards. They have a set of reference points that they use for evaluating knowledge, performance, and skill.

How have standards evolved?

NCMSC: When organizations such as NCTM began to develop standards, they considered content that educators, businesses, parents, and community members thought students should know and skills they should be able to perform in mathematics and related content areas.

For example, *Principles and Standards for School Mathematics* includes six principles that make up the core elements of a high-quality mathematics program: (1) equity, (2) curriculum, (3) teaching, (4) learning, (5) assessment, and (6) technology. NCTM also defined core content areas with corresponding standards and core process areas as well. Similarly in science, the standards provide the link between traditional subject matter categories and conceptual themes such as systems, cycles, energy, etc.

Some teachers have had a difficult time implementing standards because, for the most part, textbooks have been their curriculum, and textbooks haven't necessarily been based on standards. A great effort is being put forth to publish standards-based textbooks, along with a multitude of other standards-based materials, such as manipulatives for all content areas, videotapes, multimedia packages, and software.

How do national standards make their way into classrooms?

NCMSC: Standards make their way to classrooms through

GET TO KNOW NCMSC

The North Central Mathematics and Science Consortium (NCMSC) is one of 10 consortia funded by the U.S. Department of Education under the National Eisenhower Program. NCMSC works to advance systemic change in mathematics and science in a seven-state region: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin.

NCMSC provides direct technical assistance to state education agencies, intermediate educational units, and school districts. Based on best practice and research, these efforts focus on providing meaningful, purposeful, and engaging math and science learning experiences for all students. NCMSC also advocates the appropriate use of technology to support and accelerate systemic reform.

NCMSC provides training and technical assistance to teachers, administrators, and other educators to enable them to continuously improve teaching and learning in mathematics and science. The areas of technical assistance include:

- School improvement planning
- Product development, implementation, and evaluation
- Web site development
- Curriculum frameworks development and implementation
- Materials selection, implementation, and evaluation

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professional development. We are asking teachers to teach in a way they may not have previously experienced. Many classroom teachers were not taught, or even exposed to, this more hands-on, inquiry-, investigation-, and application-rich manner. Professional development is the key. Administrators and school leaders need to be creative and resourceful in helping teachers implement standards-based teaching into their classrooms.

The United States doesn't have a national curriculum. There are guidelines and recommendations, but no national standards. Organizations like NCTM, AAAS, and the National Research Council have introduced standards that are very likely here to stay. We in education need to work together to ensure that students see the big picture and work with important concepts and theories to develop both critical thinking skills and a deeper understanding of the processes as well as the content in a particular subject area.

What is the relationship between standards and assessment?

NCMSC: Assessment drives instruction. It's the process of measuring what areas of math, science, etc., students should know and be able to do. It's also the process of gathering information. Once data have been collected, the pieces of information are interpreted and integrated into a summary judgment. This is evaluation.

Tests, whether classroom, local, or standardized, are measuring devices to document student learning using specific questions and tasks. They are intended to produce a numerical score. The tendency in the past has been to reduce assessment to testing. In reality, tests are just one of many tools available for the assessment process.

Assessment is also a feedback mechanism. It communicates teachers' expectations for students. Teachers are constantly assessing and guiding students toward the achievement of higher levels of knowledge. As articulated in the Minnesota K-12 Mathematics Framework, assessment must reflect the standards and learning goals that are expected for all students.

What are some of the debates surrounding standards?

NCMSC: One of the debates is "basics" verses "reform-based" mathematics. None of the organizations that support "reform-based" mathematics are saying that basic content is not important. On the contrary, there needs to be a balance between the two. (See related article on page 11.)

While knowing the basic concepts and memorizing facts is essential to the learning process, applying these skills to real-life problems and situations strengthens the student's understanding of what mathematics really is. We teach reading skills all the time. And these skills are applied as students try to read and comprehend at higher levels. The same should be true for math.

We are definitely headed in the right direction, a direction in which students can build

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upon and apply basic content to everyday situations.

There are so many types of standards—content standards, performance standards, professional development standards. How do educators find a balance?

NCMSC: Teachers have come a long way in using standards, but it's still difficult for some. They don't always know where to begin. Again, the core issue to address is professional development.

Administrators and school leaders need to be creative and resourceful in how they help teachers incorporate standards into their teaching. Teachers can balance standards by networking, by planning together, by sharing. They can use what is already out there and build upon it. ●

The **American Association for the Advancement of Science (AAAS)** is the world's largest general science organization and publisher of the peer reviewed journal *Science*. AAAS serves as an authoritative source for information on the latest developments in science and bridges gaps among scientists, policymakers, and the public to advance science and science education.

www.aaas.org

The **Association for Supervision & Curriculum Development (ASCD)** is an international, nonprofit, nonpartisan association of professional educators whose jobs cross all grade levels and subject areas. ASCD produces an annual directory, entitled *Only the Best: The Annual Guide to the Highest Rated Educational Software and Multimedia*, that identifies educational software, Internet sites, and multimedia programs that have met high standards for excellence.

www.ascd.org

The **Eisenhower National Clearinghouse (ENC)** identifies effective curriculum resources, creates high-quality professional development materials, and disseminates useful information and products to improve K-12 mathematics and science teaching and learning. ENC works in collaboration with a network of regional organizations, including the Eisenhower Regional Consortia, the ENC Demonstration Sites, and the ENC Access Centers.

www.enc.org

The **National Council of Teachers of Mathematics (NCTM)** is the largest nonprofit professional association of mathematics educators in the world. NCTM offers vision, leadership, and avenues of communication for mathematics educators at the elementary school, middle school, high school, and college and university levels.

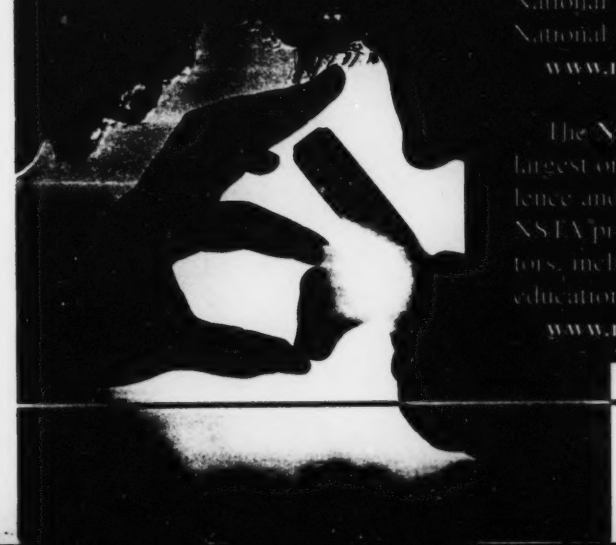
www.nctm.org

The **National Research Council (NRC)** is an arm of the National Academy of Sciences. In 1996 NRC published the National Science Education Standards.

www.nas.edu/nrc

The **National Science Teachers Association (NSTA)** is the largest organization in the world committed to promoting excellence and innovation in science teaching and learning for all. NSTA provides many programs and services for science educators, including awards, professional development workshops, and educational tours.

www.nsta.org



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feature

On the Road to REAL Progress

In a section of southeastern Ohio with scenery so stunning it could be a poster for America the Beautiful, the picture in school math and science education was bleak.

By Nancy Dreher

Early in 1999, poor performance on state tests by middle and high school students had put six Appalachian school districts on "academic emergency" and at risk for a takeover of the curriculum by the state.

Out of this serious situation arose a unique initiative. Project REAL (Rural Education Aligned for Learning) drew together five institutions in a partnership to address the problem. The Ohio University Southern Campus in Ironton, Ohio, the Ohio Department of Education, the South Regional Professional Development Center, Appalachia Educational Laboratory, and the North Central Mathematics and Science Consortium (NCMSC) at NCREL joined forces to analyze what was wrong and to find remedies for the schools in this low-income, low-employment region.

Early on the scene was Gil Valdez, NCREL's deputy director and director of NCMSC. His initial contribution was a detailed analysis of test-score data from the Ohio Proficiency Test, which serves as the primary measure of state accountability. Students were scoring above the state average on measurement, geometry, and mathematic skills. They scored considerably below the state average on conceptual knowledge, applications, and problem solving, and slightly below average on arithmetic, data analysis, and algebra. Valdez was able to study individual student test results, breaking down test questions and answers into related clusters. He then compared test results to math and science concepts students were expected to have learned and to the schools' curricula.

Says Valdez, "Analysis revealed very serious alignment issues between the Ohio Proficiency Test and the

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curriculum materials and instruction provided in most of the schools. The analysis showed that the materials and instructional strategies used in most schools covered only three of the seven areas emphasized in the state assessment."

Devising an Action Plan

This fact-finding took place early in the summer of 1999, and, by fall, Project REAL representatives were visiting the schools, examining curricula, observing classes, and talking to teachers and students. One discovery, says Valdez, was that teachers taught the basics but not enough problem solving. "Some areas were being overtaught, and others undertaught or not taught at all.

"Initially we were greeted with fear and trepidation," Valdez recalls, "until it became clear that we were there to help. Our word to teachers was, 'We're in this together; if you do not succeed, we do not succeed, either.'"

Several meetings were held during the fall of 1999 between school curriculum directors, teacher team leaders, administrators, and Project REAL members. More than 200 attended a large meeting in December 1999 that brought together the Ohio state superintendent, the state's chancellor of higher education, local school board members, and many others. Project REAL Director Tom Suter and the staff of each of the school districts involved were instrumental in this process.

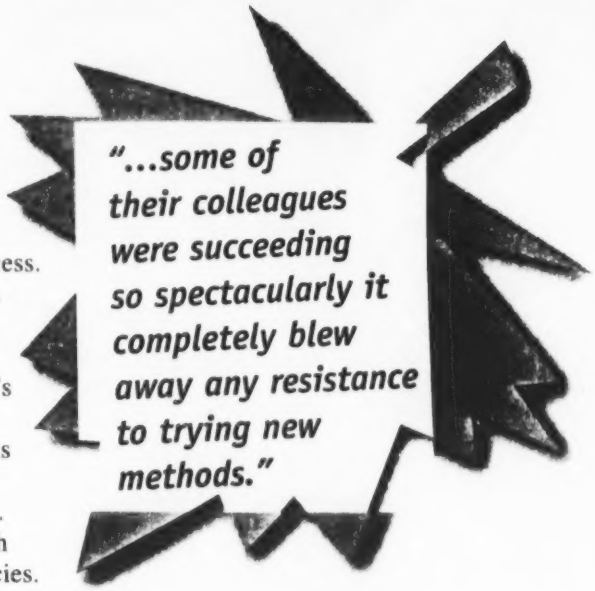
Project REAL's goals solidified. There was agreement to:

- Restructure the region's math and science curriculum so that it aligns with research-based pedagogical principles.
- Improve students' math and science competencies.
- Increase both the high school graduation and college-going rates.
- Improve teachers' instructional practices and credentials.

Already identified were several teachers whose students' good test performance stood out in contrast to the pattern of poor test scores. Those teachers, it turns out, teach with hands-on activities and problem-based learning.

"Their students learn through real-life applications that are very practical, very much tied to their lives," says Valdez. "In math, the problems are along the line of, 'How many shingles do you need to buy for a new roof?' and 'How do you figure out how much water the city water tank holds?'"

Exposure to the successful teachers' methods had a positive effect all around. "Between the test result analysis we presented and the fact that some of their colleagues were succeeding so spectacularly it completely blew away any resistance to trying new methods," says Valdez.


"...some of their colleagues were succeeding so spectacularly it completely blew away any resistance to trying new methods."

This past summer, the Ohio Department of Education committed significant funds that allowed 115 teachers to receive up to 13 days of math and science professional development. Two additional days of follow-up will come during the 2000-2001 school year.

Teachers tried new programs, finding especially appealing Connected Math from Michigan State University, Math in Context from the University of Wisconsin, and FAST Science from the University of Hawaii.

Future work will address change processes, working with adult learners in professional development settings, and implementing successful school reform. NCMSC has responsibility for the quantitative evaluation of Project REAL.

"What's the Use of Learning Math?"

"What's the use of learning math if you can't use it?"

That theme drives Becky Bowling's eighth-grade math lab at Symmes Valley Middle School in Appalachian Ohio, and—as she reveals modestly at the very end of a conversation—it has no doubt played a role in her recent nomination for Ohio Teacher of the Year.

Bowling is a practitioner of engaged learning with a hands-on, project-based approach to math instruction. Her students understand *why* they need to know math, and they have demonstrated their comprehension by achieving some of the state's highest eighth-grade Ohio Proficiency Test math scores. She began her math lab in 1998, and in the spring of 1999, 92 percent of her eighth graders passed the state math test, with similar scores in 2000.

One reason for her students' testing success, she believes, is the fact that her curriculum is aligned with the learning outcomes that the state test measures. She tailors those standards to student-friendly math projects. Geometric measurements and calculations, for example, were taught as the centerpiece of a stained glass art activity in spring 2000. Students researched the art form, did their math, and then learned how to produce their own pieces of stained glass. The project neatly combined math, art, technology, *and,* Ms. Bowling is proud to report, community service. In a special evening program, students auctioned off their artwork to parents, grandparents, school board members, teachers, and administrators and earned $2,600 for the American Cancer Society.

She credits Project REAL as an inspiration for her math program. She says her students' math success has had a ripple effect on the curricula of other teachers at Symmes Valley, a school where 60 percent of the students are on a free or reduced-fee lunch program. "With the help of Project REAL," she explains, "we're proving that we can shine!"

To learn more about Ms. Bowling's approach to teaching math, see her blackboard course on the Ohio University Web site at *http://blackboard.southern.ohiou.edu.*

"...students learn through real-life applications that are very practical, very much tied to their lives."

"This project is very significant to our research agenda," says Valdez, "because this is one of the few high-poverty regions that is undergoing significant research-based reform in mathematics and science and also has sufficient stability of population to allow longitudinal analysis."

Project REAL is still in its early stages, as far as results are concerned. But two of the six districts have reported increases in the number of students reaching proficiency—and the number of proficiencies reached by the schools themselves. This early evidence offers hope that the beautiful Appalachian vistas will soon be matched by the view of rising test scores. ●

For More Information

Project REAL Web site: **www.zoomnet.net/~tsuter/real**

NCREL's Project REAL Web page: **www.ncrel.org/rural/geo/ncrel/toa.htm**

11

MATH WARS

By Julio Abreu

Dear Mr. Washington:

We are writing to you because we have some concerns about your new math program. As we have tried to help Jared with his math assignments over the last few weeks, we have developed some serious doubts about the program's effectiveness.

From our own educational experiences and common sense, we would expect Jared to have mastered his multiplication tables by now. However, he still seems to need more practice, but you have moved on to another math topic. How will Jared excel in future math classes if he hasn't memorized his tables? Also, we don't understand why you are stressing that math problems can be solved in a variety of ways. Isn't that misleading and confusing for students who need to learn specific, practical math formulas?

Finally, we are surprised that you don't appear to rely sufficiently on the math textbook. Often, Jared brings home math study packets. Is there something wrong with the textbook you just adopted and/or is this your own unique approach to the teaching of math?

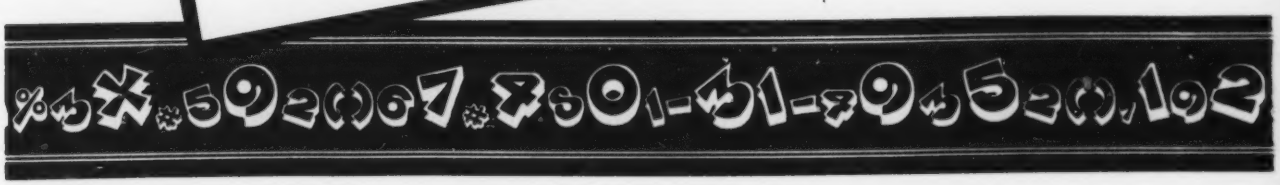
We would appreciate your response to our concerns. As you can imagine, we want to make sure Jared does well in math and is properly prepared for future math classes.

Sincerely,

Mr. and Mrs. Esposito

If the subject of this letter seems very familiar, chances are you've become part of the growing group of educators trying to manage the challenging transition from traditional math instruction to what is known as "new-new" math. But why the need for a change?

Four decades ago, following Russia's Sputnik satellite launching, our nation embraced "new" math as part of a commitment not to fall behind our global neighbors. While "new" math may have provided a necessary impetus toward academic excellence, its emphasis on the memorization of theories and formulas did not revolutionize or enhance math instruction.



Consequently, recent international studies still indicate that our students have not caught up to the level of math achievement in other advanced nations.

REALITY CHECK

Over the last 11 years, with the introduction of national math standards, a concerted reform effort has led to the "new-new" math approach. At the heart of the standards is the goal of making mathematics education as *real-life oriented* as possible. Behind this thinking is the awareness that our students will enter a technology- and information-driven society that will require them to be very math-savvy, creative problem-solvers.

Below are some of the key issues addressed in the "new-new" mathematics:

- All students must have equal access to appropriately challenging learning.
- The mathematics process includes problem solving, reasoning and proof, communications, and the ability to understand how mathematical elements are represented in different ways.
- Mathematical problems may be solved in multiple ways.
- Technology does not replace the teacher or basic skills. Rather, it is an essential teaching tool; it influences the mathematics that is taught and enhances student learning.

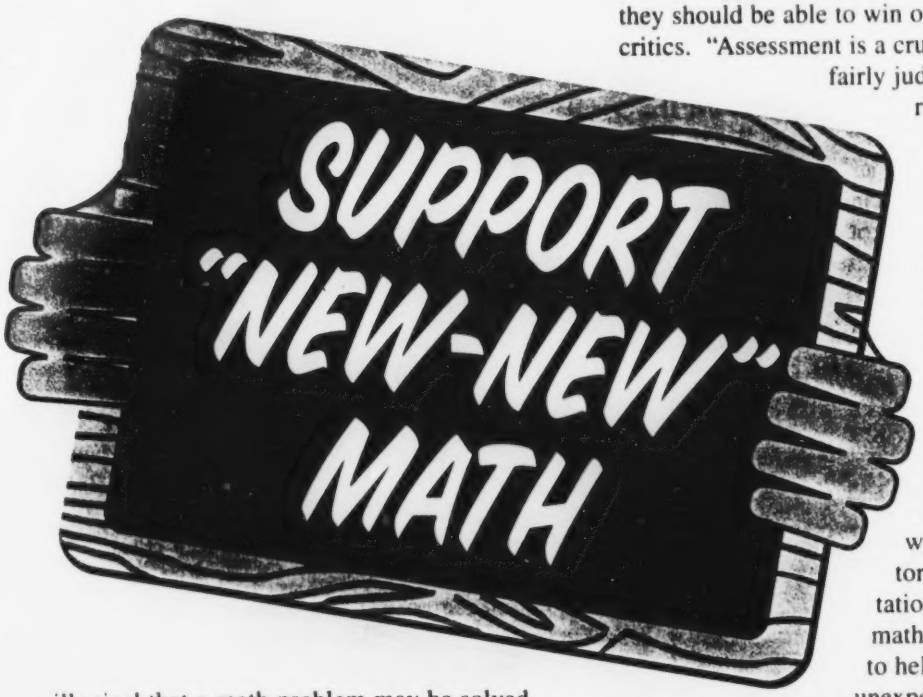
BATTLE LINES DRAWN

Critics of the "new-new" math tend to believe that the reformers have made the mistake of moving away from basics such as computation and practice. In this group are many parents who worry that their children are not focusing enough on learning multiplication, long division, and other skills that just one generation ago were considered essential.

Proponents of the "new-new" math assert that they support computation, especially in the elementary grades. However, they point out that the traditional approach *overemphasized* the drill and practice of formulas without providing students with sufficient understanding of their real-life application. For example, a teacher using "new-new" math techniques might reinforce a multiplication lesson by having students measure how much carpeting they would need to cover their classroom—or bedroom—floor. As Barbara Youngren from

the North Central Mathematics and Science Consortium (NCMSC) points out, "In support of the math standards, the 'new-new' math still considers math content—like memorizing multiplication facts—very important for students to learn. It is more the math *processes* that are evolving as the workplace demands more creative problem-solvers."

Some defenders of back-to-basics also question the merit of stressing creative problem-solving. For example, to some critics, it seems illogical that a math problem may be solved in multiple ways. "What some people overlook," notes Youngren, "is that in everyday life and work, it is a real advantage to know different ways to solve a problem. What if, say, there were only one way to buy a house or car? Equally important, being able to solve problems in a variety of ways empowers children with different learning styles. One student's approach is as valid as another's—assuming that similar results are achieved," Youngren adds.



TRUCE AND BEYOND

There appears to be some hope for a truce in the math wars. The "new-new" math side is trying to clarify misconceptions about its approach that may be confusing to different stakeholders. As mentioned previously, reformers say computation is not on the "new-new" math hit list. Also, as school districts that adopt the new approach can show its effectiveness, they should be able to win over more of their critics. "Assessment is a crucial component of fairly judging any new curriculum program," stresses Youngren. And she adds, "Without assessment tools and quantifiable results, no one will be satisfied—and students will pay a dear price."

In some cases, supporters of back-to-basics (especially parents) who have been monitoring the implementation of "new-new" math instruction are able to help districts identify unexpected challenges during the changeover to the new approach.

The truth is, for some teachers the "new-new" math is just that—BRAND NEW. Well-planned and comprehensive professional development in the area of mathematics pedagogy and methodology will increase the knowledge base for teachers and enhance the instruction for students, thus taking advantage of the best of *all* math worlds. ●

feature

Environmental Science Along the

By Nancy Dreher

Few areas present better opportunities for environmental science education than local waterways. This is especially true in the state of Michigan. It is crisscrossed by hundreds of small rivers and lakes that are ideal labs for enterprising teachers and curious students.

In the Grand Traverse Bay area of northwest lower Michigan, for example, an outstanding educational initiative exists in the form of *Water Watch,* a program based on the "action research" principle that takes student participants beyond simple rote learning and into applied problem-solving.

More than 1,200 students in grades 5 to 12 monitor 50 sites on 15 area rivers and streams to learn more about water resources and to explore the land/water relationships of their community. The program is a collaboration between teachers and their schools and two nonprofit organizations: the Grand Traverse Bay Watershed Initiative and the Grand Traverse Regional Math, Science, and Technology Center.

Like most successful programs, *Water Watch* has generated ideas for offshoot projects that enhance the curricula in individual schools. A prime example is Buckley, a small 400-student K-12 district where participation in *Water Watch* led to the creation of an entirely new high school science class centered around the study of all aspects of water.

The class owes its existence to an environmental controversy. In 1998, Bill Queen, then-head of the Grand Traverse Bay Watershed Initiative, suggested that Buckley science teacher John Nickerson might find an interesting study project along the Platte River, where a landowners association had filed a lawsuit charging a fish hatchery with polluting the river with phosphates and nitrates.

Nickerson took the bait. Starting with the 1998-99 school year, he and the students in his new Environmental Science II class (primarily sophomores) began monitoring six sites along a 20-mile stretch of the Platte River. Five times a year, he and his approximately 20 students make the 30-mile bus trip to test the Platte for chemicals and macroinvertebrates found in the river.

They break up into five groups. One group of students tests the water for chemicals, and the others take nets and spread out into four specific areas:

- Quiet areas of the river, where water collects in little pools
- Areas where weeds are growing on the riverbed and along the riverbank
- Areas with floating debris, logs, and rocks that can be collected from the riverbed
- The river's "riffle," where the water is shallow and fast-moving

Students gather the invertebrates and bring them ashore to identify and classify them

John Nickerson

Water

using a system called the Water Pollution Tolerance Index. Developed by the Izaak Walton League's Save Our Streams program, the index is based on the premise that certain organisms—insects, crayfish, and snails, among others—are very good indicators of water quality.

Students record data on a chart that assigns points to the invertebrates: three points for every type of "desirable" organism, such as mayflies, that thrives only in clean water; two points for organisms that are not necessarily indicative of good or bad water; and one point for creatures, such as leeches, that live in poor-quality water.

These measurements are taken at six distinct sites along the river: one at a spot upstream from the fish hatchery and another below it; one above the small village of Honor and another below; and one where the Platte enters Big Platte Lake and another where it exits. Testing takes place in late September/early October, early November, March, April, and May.

"After the first two times, the students really know what they are doing and cover a lot of ground fast," says Nickerson. "They become very involved. The water testing creates a lot of questions—and then still more follow-up questions—in students' minds. At the beginning, they don't realize the river is full of life. Then they develop a lot of respect for the river and concerns about keeping it clean. They begin to realize that it's not just water."

Better yet, says Nickerson, students come away with experience in the practical use of science. "Our testing is not that difficult to do. The technology is not that hard. But you do have to be able to classify, collect data, use data to create charts, and make accurate measurements. Then we try to analyze our results. This offers great learning opportunities." Nickerson hopes his data will become part of a study of the Platte River by Benzie County, which recently received a grant from the U.S. Environmental Protection Agency (EPA) for that purpose.

Nickerson credits the Grand Traverse Regional Math, Science and Technology Center (MSTC), headed by Gary Money, as well as Bill Queen and many others, for supporting his class. "Gary and Bill have really helped out with their encouragement and funding. This has allowed me to create a high-quality program."

It's a program that has attracted wider attention. The Grand Traverse Regional MSTC has just awarded the Platte River brigade a trip to the Lake Superior Youth Symposium in May 2001. There they will present their project and meet other students from Michigan, Wisconsin, and Minnesota, as well as Ontario, Canada.

RESOURCES

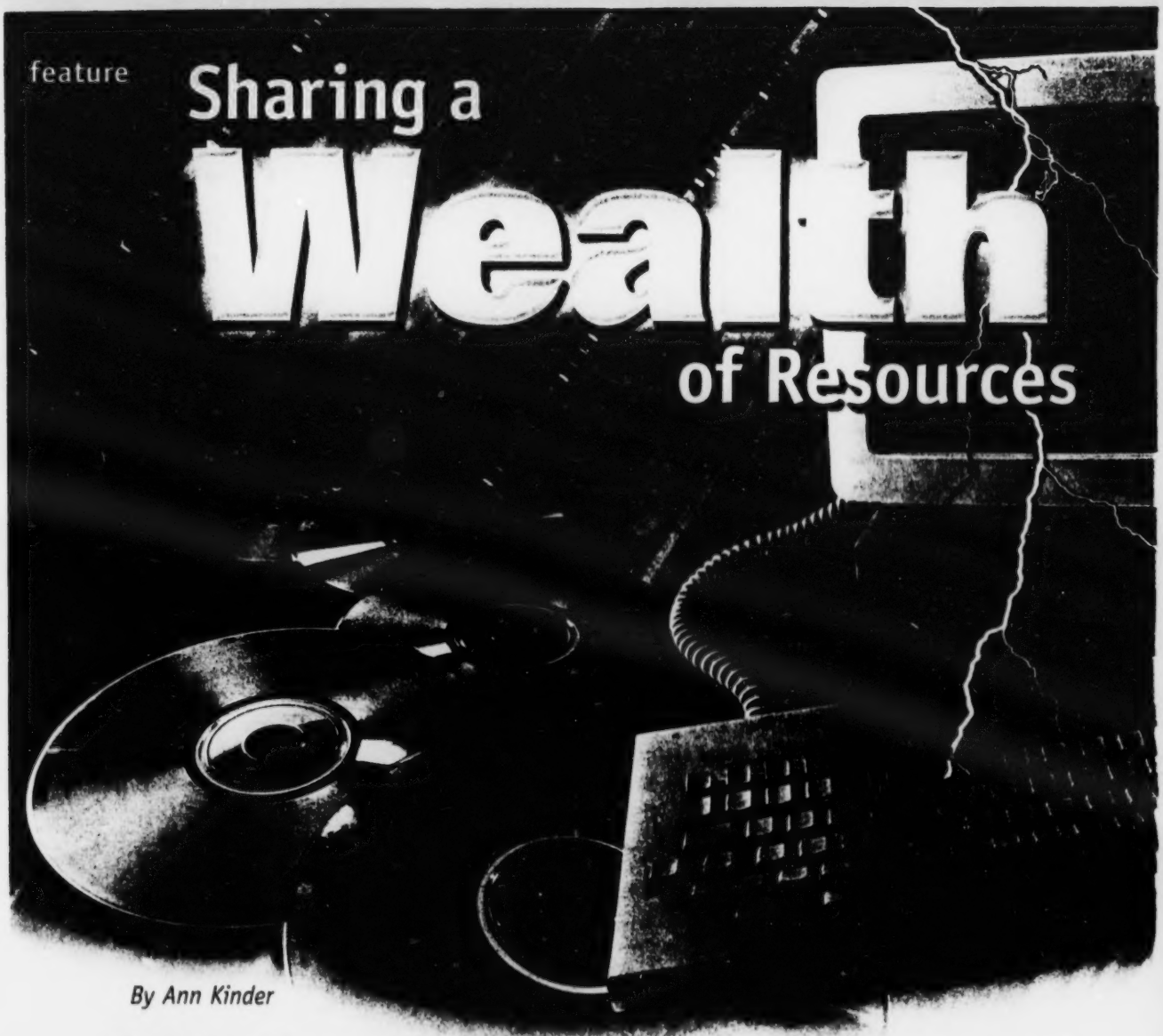
You'll find a wealth of valuable information on the Grand Traverse Regional Mathematics, Science, and Technology Center Web site: *www.gtmathsci.org*. Click on *Water Watch* for information specifically related to that program.

The school monitoring program is also described at: *www.traverse.com/nonprof/gtbwi/green/bay.html*.

Michigan State University provides extensive descriptions of the Grand Traverse Bay Watershed on the following Web site: *www.lrm.msu.edu/gtbw/watershed.htm*.

feature

Sharing a Wealth of Resources



By Ann Kinder

Wouldn't it be great to have a rich collection of math, science, and technology materials at your fingertips? Well, dream no more because such a place now exists. It is one of the Eisenhower National Clearinghouse's (ENC) regional demonstration sites housed at the Lederman Science Center in Batavia, Illinois.

At first glance, the distinct Japanese architecture of the Lederman Science Center might lead you to believe you had been transported thousands of miles across the Pacific Ocean. Actually, the center is situated on a quiet prairie at the Fermi National Accelerator Laboratory in northeastern Illinois.

The center is home to Fermilab's Teacher Resource Center (TRC), and it's no coincidence that TRC was chosen as a demonstration site for the Eisenhower National Clearinghouse. TRC currently has a collection of more than 12,000 math, science, and technology resources—one of the largest anywhere.

According to Susan Dahl, an education specialist at Fermilab's TRC, the idea to develop a resource center surfaced in 1986 when local teachers informed Fermilab that they needed a place where they could find up-to-date curriculum materials. Around that same time, the Illinois School Library Media Association conducted a statewide survey on the quality of tradebooks in schools. The results of the survey revealed that school collections were modest and outdated.

"TRC opened its doors in 1989," recalls Dahl. "The ENC demo site opened soon after that. A wide range of education-oriented people use the site—classroom teachers, preservice teachers, parents, professors, home-school teachers, librarians, and

park district education coordinators. Even institutional partners, such as The Field Museum of Natural History in Chicago, use our resources. Basically, we serve educators from all over the world."

Perfect Partnership

The North Central Mathematics and Science Consortium (NCMSC) at NCREL was instrumental in helping TRC obtain "demo site" status. NCMSC leveraged the regional resources of both the U.S. Department of Education and the U.S. Department of Energy by forging a partnership between ENC and Fermilab's TRC in order to develop the Midwest demonstration site.

NCMSC and the TRC demo site have an especially unique and effective relationship. They collaborate on activities such as software reviews for educators, science resource fairs, Internet awareness workshops, and organized activities that fulfill individual needs.

"Our missions overlap in the areas of technology and resources," explains Marjorie Bardeen, education manager at Fermilab. "In a formal capacity, we serve on advisory boards, and in a less formal capacity, NCMSC supports some of our programs with funding that meets needs identified by assessments and surveys."

With this partnership, both NCMSC and the Lederman Science Center can offer extensive resources and activities to a broad audience far beyond the borders of the Midwest. In addition, materials produced by NCMSC and NCREL are readily available for use in programs offered by Fermilab.

Curriculum Cornucopia

TRC visitors have an opportunity to preview materials such as tradebooks, videotapes, reports, legislation, CD-ROMs, and more. Also, a variety of workshops are offered. Some of the more popular topics include multimedia awareness, technology integration, and intermediate Internet topics.

"We have over 1,000 titles in our software collection," states Bardeen. "This includes not only math and science, but language arts and social studies as well. Also, teachers look for data collecting tools and software that have age-appropriate instructional design." TRC staff always strives to provide educators with the resources and assistance they need. Dahl recalls a particular story that demonstrates their dedication.

"A group of middle school teachers from a district in Oak Lawn [Illinois] came into the center one day looking for professional development videos," explains Dahl. "They had just finished the process of planning curriculum that would bring more inquiry-based learning into their classrooms. We started to have some conversations about their new approach to student involvement, and the next thing we knew, two principals and some folks from our science center joined in the discussion."

The outcome of this meeting was that several teachers from the district participated in an inquiry-based workshop organized by TRC. The teachers chose one lesson and transformed it into a less traditional, more inquiry-based unit. One teacher was so motivated by everything she learned in the workshop that she was at TRC the very next day looking for more resources. "The participants in our programs feel like they're part of a partnership," states Dahl. "They're the ones who help disseminate the word that we're here."

TRC has other means of letting educators know about their services. *Sciencelines* is a quarterly education newsletter at Fermilab that helps promote the ENC demonstration site. Also, TRC staff help spread the word by attending conferences, giving presentations, and updating the Web site (*www-ed.fnal.gov/programs/ed_mat_trc.html*). The education Web site at Fermilab (*www-ed.fnal.gov*) receives more than 2 million hits a year.

Bardeen sums up TRC's approach when she says, "The science community and the science education community don't have to be two separate entities. Here, we have found a way to work together to meet our common goals." ●

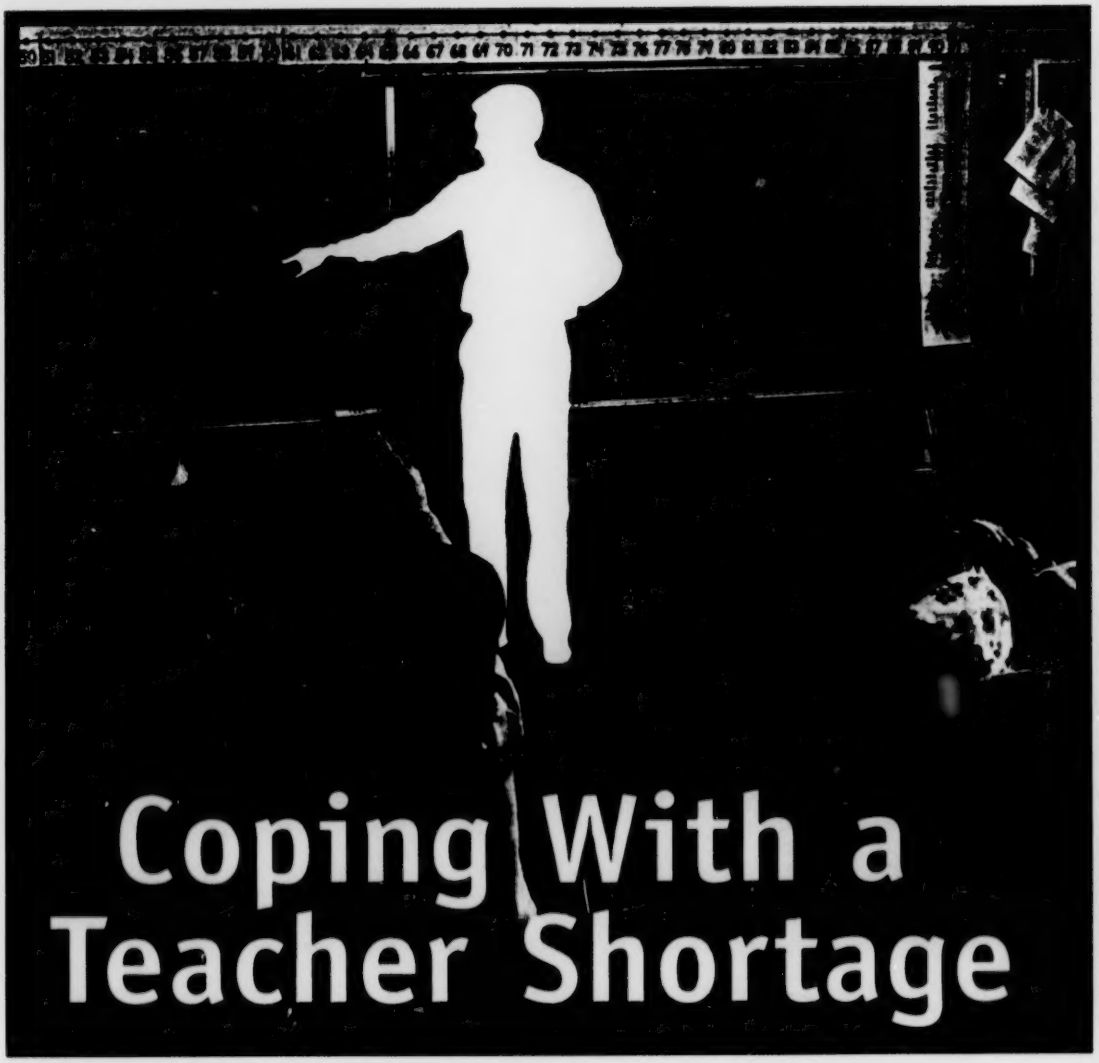
Resources

To contact TRC and the ENC Demonstration Site:

Write: P.O. Box 500, Batavia, IL 60510
Call: 630-840-8259
E-mail: sdahl@fnal.gov

Open Monday through Friday, 8:30 a.m. to 5 p.m. and the 1st and 3rd Saturdays of each month from 9 a.m. to 12 noon. Appointments preferred.

feature



Coping With a Teacher Shortage

By Ann Kinder

It's been said that the Midwest is the chief exporter of the nation's largest crop of teachers. However, with projections of massive retirements, competition from other states, and teachers leaving the profession, the region now faces critical shortages. Curriculum areas such as special education, technology education, mathematics, and science are all facing teacher shortages.

Policymakers across the country are not taking this situation lightly. In a recent public radio address, President Clinton announced that this year, schools have the largest enrollment in our nation's history. He further explained that many school districts are struggling to fill vacant teaching spots and predicted this problem will only escalate over the next decade as the nation scrambles to hire 2.2 million teachers.

President Clinton introduced the first ever national, online teacher recruitment clearinghouse *(http://www.recruitingteachers.org)* to help combat this problem. School districts can log-on to find qualified teachers, and teachers can search for jobs. The Web site also provides educators with the latest updates on recruitment, retention, certification, incentives, and pay.

Although the recruitment clearinghouse is a step in the right direction, state policymakers are taking even further measures to attract and

Corbis

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retain teachers. States—from California to Maine—are beginning to put incentives in place such as signing bonuses, tuition reimbursement, student loan payoffs, and down payments for homes. Massachusetts went as far as proposing that the first $30,000 of income earned by highly qualified teachers be exempt from federal income tax. In East Aurora, Illinois, teachers agreed to a contract that links pay raises to improvements in district test scores.

The Quality Factor

President Clinton is calling for talented and dedicated teachers in every classroom. But can that be accomplished with a teacher shortage at hand? According to a report released earlier this year, entitled *Teacher Shortages in the Midwest: Current Trends and Future Issues*, NCREL researchers noted that looking at teacher supply and demand numbers without considering quality is dangerous.

The report states that one obvious negative impact of teacher shortages is unfilled teaching positions. But perhaps a less obvious and more serious impact is that positions may be filled with ineffective teachers. Research shows that teacher quality is a key component of increasing student achievement. Yet many states have been forced to grant alternative certification in an attempt to fill empty classrooms.

"Research shows that teacher quality is a key component of increasing student achievement. Yet many states have been forced to grant alternative certification in an attempt to fill empty classrooms."

Opponents of this type of approach to licensure point out that such policies ignore the range of abilities and knowledge required of skillful teachers. Fortunately, many states and districts have developed practical, effective solutions. Among these solutions are:

- Common state standards for cross-state licensing
- Expanded teacher education programs in high-need subjects
- Increased teacher standards equalled by increased teacher pay
- Mentor/induction programs for teachers
- Incentives to teach in troubled communities

NCREL's study on teacher shortages in the Midwest found that most states in this region do not have enough information to make policy decisions about teacher supply and demand. Meaningful, comparable, and current data is not available in a number of key areas. The writers of the report recommend that state agencies and legislatures take action to make data collection and analysis a priority. They also suggest that more steps be taken to make policymakers and the general public aware of essential, not just obvious, information with regard to teacher supply and demand.

Although progress is being made, policymakers and educators have a lot of work ahead in order to fill unoccupied teacher positions with qualified personnel and to motivate existing teachers to continue down their current career path. ●

For More Information

Teacher Shortages in the Midwest: Current Trends and Future Issues by Debra Hare, Joe Nathan, and John Darland, Center for School Change, University of Minnesota, and Sabrina Laine, NCREL. Available at: *www.ncrel.org/catalog*

NCREL NEWS &

North Central Regional Educational Laboratory

Curriculum Mapping Made Easy

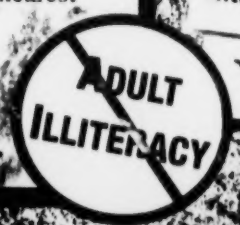
Does your school try to teach too many topics? Are topics retained in your curriculum too long? Research from the Third International Mathematics and Science Study (TIMSS) indicates that American schools include too many topics and retain material too long to allow for in-depth instruction. Use this Web site to plot information about your school's curriculum. Compare displays of your school's mathematics and science curricula to curricula of top-achieving nations as you make decisions about what should and should not be included in your curriculum. Visit **www.ncrel.org/currmap** today!

New Tools for Technology PD

You won't want to miss this site if it's your responsibility to develop and implement professional development geared to help integrate the use of instructional technologies. At **www.ncrel.org/tech/pd** you'll find tools, sample activities, and information resources to support your plans and designs.

NCREL Combats Adult Illiteracy

NCRTEC recently partnered with the National Center on Adult Literacy to produce a series of multimedia videos and CD-ROMs. The *Captured Wisdom on Adult Literacy* videos and CD-ROMs are interactive resources that help teachers integrate technology into adult education instruction. They provide real examples of educators and students using technology in their classrooms as a tool to support instruction and learning. This comprehensive resource package is available at State Literacy Resource Centers across the country. Locate the nearest center by visiting the National Institute for Literacy online at: **www.nifl.gov/nalld/nalld_states.html.**



Ready, Set, enGauge!

Scheduled for piloting in fall 2000, enGauge is a new Web-based framework and tool set designed to help schools and districts use technology effectively for learning, teaching, and managing. The framework identifies six essential conditions critical to effective uses of technology for student learning. The enGauge Web site will help schools and districts see how technology can advance student learning; learn about the educational system conditions required to use technology effectively; complete online assessments; compare school or district technology profiles to national data; develop an informed plan of action; and track and report progress to policymakers.
http://engauge.ncrel.org

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NOTES

Achieving Accessibility for All

Do you take the abundant benefits of the World Wide Web for granted? Some Web users have difficulty hearing or seeing Web pages. For those with special needs, graphics, multimedia, graphs, charts, frames, etc., can be presented with text, captioning, explanation of content, and/or alternative content. For help with these and other accessibility issues, contact **ncrtec@ncrel.org.**

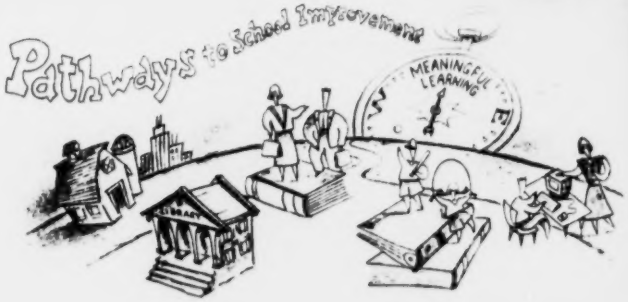
Who Is EdSTAR?

Rather, what is EdSTAR? It's one of a kind in NCREL's region—a Web site that connects educational standards with technology, applications, and resources. This comprehensive Web site focuses on improving student achievement through attention to high standards. The site provides teachers with substantive help, direction, and professional development in the area of Minnesota State Standards implementation. A similar site is in development for Wisconsin. Find EdSTAR online at **http://edstar.ncrel.org.**

Coming Soon!

Imagine going to one place and finding answers to questions about how to make the vision of effective technology use a reality in your school. Visit the "What's New" section of NCREL's home page at **www.ncrel.org** and watch for news of our "Smart Library" on technology vision.

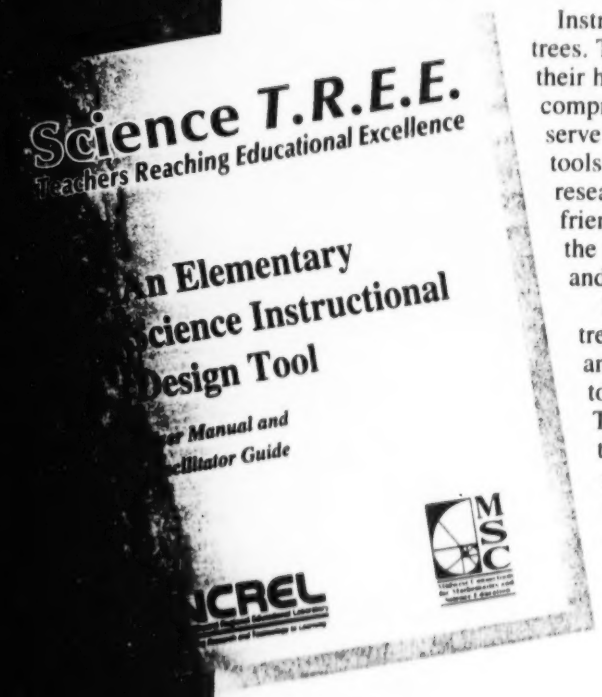
Critical Issue—School Governance



What is site-based, or school-based, management? Who does it involve? Does it make a difference in student performance? These questions and more are addressed in the latest *Pathways to School Improvement* Critical Issue—Implementing Site-Based Management to Support Student Achievement. This reform initiative promises to place more authority in individual schools through the adoption of a more democratic decision-making process. As always, Pathways' writers, researchers, and educators present this issue with multiple viewpoints, methods of action, implementation pitfalls, illustrative cases, and more. For additional information, visit: **www.ncrel.org/sdrs/areas/issues/envrnmnt/go/go700.htm.**

products & services

Science T.R.E.E. (Teachers Reaching Educational Excellence)
by Barbara Sandall and Judith Longfield



Instructional design tools don't just grow on trees. That's why educators are clamoring to get their hands on NCREL's *Science T.R.E.E.*, a comprehensive CD-ROM and guidebook that serve as elementary science instructional design tools. *Science T.R.E.E.* combines best practices, research, and national standards in a user-friendly resource to guide educators through the process of designing lesson plans, units, and curricula with the help of five templates. Each template is cleverly named after a tree—apple, sequoia, maple, oak, and pine—and focuses on topics from engaged learning to learning strategies and learner objectives. The easy-to-use design and format of this tool will help educators plan high-quality standards-based science investigations, units, and curricula, while learning about science content, instruction, and assessment.

Blueprints
A product of the Eisenhower Regional Consortia for Mathematics and Science Education and the Eisenhower National Clearinghouse

Whether you're an experienced facilitator or aspiring to be one, the *Blueprints* CD-ROM will help you learn how to create effective professional development programs for math and science educators. By adapting more than 80 activities on the disc, you can assist educators with planning professional development, crafting curriculum, refining instructional practice, and making assessment decisions. This computer-based toolkit for facilitators combines the use of interactive group processes with content and a template for creating a professional development plan. *Blueprints* CD-ROMs are distributed at professional development training sessions and by other mathematics and science consortia.

Order these FREE products online at: **youngren@ncrel.org**. Or, for further information about *Science T.R.E.E.* and *Blueprints*, visit NCMSC online at **www.ncrel.org/msc/msc.htm** and click on "Products."

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Expanding Your Horizons

A practical way to broaden your science and mathematics curriculum horizon is to participate in local, regional, or national organizations. By attending professional gatherings, you can find out how others cope with similar challenges, present your own success stories, and network with educators sharing the same interests and goals.

To that end, listed below are state-specific organizations within the NCREL service region that you may wish to look into and contact. Also listed are locations, dates, and Web addresses for information on upcoming national conferences that address key science and mathematics education issues.

State Mathematics Education Organizations

Illinois Council of Teachers of Mathematics
www.ictm.org

Indiana Council of Teachers of Mathematics
http://users.anderson.edu/~roebuck/ICTM.html

Iowa Council of Teachers of Mathematics
http://lserver.aea14.k12.ia.us/ICTM/ictm.html

Michigan Council of Teachers of Mathematics
www.mictm.org

Minnesota Council of Teachers of Mathematics
www.mctm.org

Ohio Council of Teachers of Mathematics
http://ohioctm.org

Wisconsin Mathematics Council, Inc.
www.wismath.org

State Science Education Organizations

Illinois Science Teachers Association
www.ista-il.org

Hoosier Association of Science Teachers, Inc.
www.hasti.org

Iowa Science Teachers Section
http://ists.pls.uni.edu

Michigan Science Teachers Association
www.MSTA-Mich.Org

Minnesota Science Teachers Association
www.mnsta.org

The Science Education Council of Ohio
http://cc.owu.edu/~seco

Wisconsin Society of Science Teachers
www.wsst.org/WSST.htm

National Council on the Teaching of Mathematics
Annual Convention
Orlando, Florida
April 4-7, 2001
Theme: Math World: New Standards for the New Millennium
www.nctm.org/meetings/annuals/orlando

American Association for the Advancement of Science
Annual Convention
San Francisco, California
February 15-20, 2001
www.aaas.org/meetings/2001

Association for Supervision and Curriculum Development
Annual Convention
Boston, Massachusetts
March 17-19, 2001
Theme: Reaching for Balance/ Resolving Educational Dilemmas
www.ascd.org/site.html

National Science Teachers Association
Annual Convention
St. Louis, Missouri
March 22–25, 2001
www.nsta.org/conv/natgen.asp

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NCREL
North Central Regional Educational Laboratory

NCREL's
LEARNING POINT

A publication of the North Central Regional Educational Laboratory

Gina Burkhardt,
Executive Director

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NCREL's Learning Point is produced in cooperation with A+ Media, Inc. (847-205-3071).

Printed on recycled paper

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ABOUT NCREL
The North Central Regional Educational Laboratory is a nonprofit organization dedicated to helping educators—and the students they serve—reach their full potential. For over 15 years, NCREL has provided research-based resources and professional development opportunities for teachers, administrators, and policymakers throughout the Midwest. Supported by the U.S. Department of Education, NCREL serves a seven-state region, including Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin.

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